CLAIMS

WHAT IS CLAIMED IS:

1. An apparatus for irradiating target objects comprising:

an x-ray source emitting x-rays; and

a relative positioning apparatus translating at least one of the target objects positioned by said relative positioning apparatus in relation to and impinging upon said x-rays.

2. The apparatus as set out in claim 1 wherein said x-ray source includes a medical or industrial linear accelerator having an x-ray generating target.

3. The apparatus as set out in claim 1 wherein said x-ray source includes means for emitting an x-ray beam including said x-rays and said apparatus for irradiating target objects further comprises means for shaping said x-ray beam.

4. The apparatus as set out in claim 1 wherein said target objects include a medical stent and said relative positioning apparatus includes a stent relative positioning apparatus.

5. The apparatus as set out in claim 1 wherein said relative positioning apparatus includes a rotatable carousel at least a portion of which impinges upon and receives at least a portion of said x-rays, said rotatable carousel including at least one target mount for retaining at least one target object in fixed relation to said rotatable carousel.

6. The apparatus as set out in claim 5 wherein said rotatable carousel has at least one rotation angle at which each said at least one target mount impinges upon and receives said x-rays emitted from said x-ray source and at least one rotation angle at which said at least one target mount does not receive said x-rays.

7. The apparatus as set out in claim 1 wherein said relative positioning apparatus includes a tube assembly having:

a stationary member defining an interior path for receiving at least one of said target objects; and

a translation assembly for moving said at least one target object along a path within said stationary member, said path impinging upon said x-rays emitted from said x-ray source.

8. The apparatus as set out in claim 7 wherein said stationary member defining an interior path is a tube.

9. The apparatus as set out in claim 7 wherein said tube assembly further comprises a heat transfer apparatus supplying a heat transfer fluid within the interior of said stationary member defining an interior path.

10. The apparatus as set out in claim 7 wherein said translation assembly includes linear and rotational translation apparatus.

11. The apparatus as set out in claim 7 further comprising a plurality of members each defining an interior path and having an associated translation assembly for moving at least one of said target objects along said interior path within each said member defining an interior path, each said interior path impinging upon said x-rays emitted from said x-ray source.

12. The apparatus as set out in claim 7 wherein said stationary member defining an interior path includes an x-ray source activated by said beam of electrons to emit x-rays.

13. The apparatus as set out in claim 1 wherein said relative positioning apparatus includes a tube assembly having:

a substantially stationary tube defining an internal target object conduit path; and

a translation assembly for moving at least one of said target objects within said stationary tube along a desired path impinging upon said x-rays emitted from said x-ray source.

14. The apparatus as set out in claim 1 further comprising:

at least one sensor measuring parameters selected from a group including electron beam current, temperature, and radiation; and

a control circuit controlling the electron beam provided by said electron beam source based on said parameters measured by said at least one sensor.

15. The apparatus as set out in claim 14 wherein said at least one sensor includes a radiation detector situated downstream of said relative positioning apparatus.

16. The apparatus as set out in claim 14 wherein said at least one sensor includes a metering circuit measuring the electric current received in said x-ray conversion target.

17. The apparatus as set out in claim 14 wherein said at least one sensor includes a temperature monitoring device measuring the temperature in proximity of said relative positioning apparatus.

18. The apparatus as set out in claim 14 wherein said at least one sensor includes:

a radiation detector situated downstream of said relative positioning apparatus; and

a metering circuit measuring the electric current received in said x-ray conversion target.

19. The apparatus as set out in claim 1 further comprising a radiation detector downstream of said relative positioning apparatus.

20. The apparatus as set out in claim 2 wherein said x-ray conversion target further comprises a metering circuit measuring the electron beam current received by the x-ray conversion target.

21. The apparatus as set out in claim 1 wherein said relative positioning apparatus includes a fixed positioning member retaining said at least one of the target objects in generally fixed relation to said x-ray source while positioned in the path of said x-rays.

22. The apparatus as set out in claim 1 further comprising an electron beam directing apparatus between the electron beam source and the x-ray conversion target.

23. The apparatus as set out in claim 22 wherein said electron beam directing apparatus includes a magnetic means for directing the electron beam.

24. The apparatus as set out in claim 1 further comprising a heat transfer system conducting heat away from said x-ray conversion target.

25. The apparatus as set out in claim 24 wherein said heat transfer system includes a conduit for conveying a heat transfer fluid.

26. The apparatus as set out in claim 1 further comprising a thermal shield between said x-ray conversion target and said at least one of the target objects positioned on said relative positioning apparatus.

27. The apparatus as set out in claim 1 wherein said x-ray conversion target includes a plurality of layers wherein:

at least a first one of said layers comprises said x-ray generating material;

at least a second one of said layers comprises an electron absorption apparatus between said x-ray generating material layer and said at least one target object positioned by said relative positioning apparatus.

28. The apparatus as set out in claim 27 further comprising a thermal shield between said x-ray conversion target and said relative positioning apparatus.

29. The apparatus as set out in claim 1 further comprising a chamber downstream of the x-ray source, said chamber including a target object entry port and wherein said relative positioning apparatus includes a translation armature extendable through said target object entry port.

30. The apparatus as set out in claim 29 wherein said translation armature includes a linearly translatable member mounting for receiving said at least one target object wherein the linearly translatable member defines a translation path including a first position within said chamber impinging upon said x-rays, and a second position outside said chamber wherein said at least one target object is movable on said linearly translatable member between said first position and said second position, through said entry port.

31. Apparatus for irradiating target objects comprising:

an electron beam source providing a beam of electrons;

a positioning assembly including a rotatable carousel having an axis of rotation and a radial edge, the electron beam source directing said beam of electrons to impinge upon and be received by the radial edge of said rotatable carousel, said rotatable carousel including:

an x-ray generating material in the rotatable carousel activated by said beam of electrons to emit x-rays;

a mounting station receiving at least one of said target objects said mounting station receiving x-rays emitted by said x-ray generating material.

32. The apparatus as set out in claim 31 wherein said positioning assembly includes a plurality of mounting stations each mounting at least one of said target objects in a generally fixed relation to said x-ray conversion target.

33. The apparatus as set out in claim 31 wherein said electron beam is directed perpendicular to the axis of rotation of said rotatable carousel.

34. The apparatus as set out in claim 33 wherein said x-ray generating material includes an x-ray generating material doped in said rotatable carousel.

35. The apparatus as set out in claim 33 wherein said carousel includes a carbon-carbon fiber doped with said x-ray generating material.

36. The apparatus as set out in claim 31 wherein said rotatable carousel is rotatable from a first position in which said mounting station is aligned with said electron beam and a second position in which said mounting station is outside the path of said electron beam.

37. The apparatus as set out in claim 31 further comprising a heat transfer system conducting heat away from at least one of the carousel, x-ray conversion target and target object.

38. The apparatus as set out in claim 37 wherein said heat transfer system includes a conduit for conveying a heat transfer fluid.

39. The apparatus as set out in claim 37 wherein said heat transfer system includes a plurality of fluid conduits in said rotatable carousel.

40. The apparatus as set out in claim 31 further comprising an electron beam directing apparatus between said electron beam source and said carousel.

41. Apparatus for irradiating target objects comprising:

an electron beam source providing a beam of electrons;

a positioning assembly including a linearly movable translation armature, said translation armature mounted to said positioning assembly at least for linear motion in an axial direction, and said translation armature including a mounting apparatus mounting at least one of said target objects; and

an x-ray conversion target mounted on said translation armature between said translation armature and said electron beam source, wherein said x-ray conversion target defines a radial access region providing access to said at least one target object and said x-ray conversion target includes an x-ray generating material activated by said beam of electrons to emit x-rays.

42. The apparatus as set out in claim 41 wherein:

said positioning assembly includes a means for moving said x-ray conversion target mounted on said translation armature between a first position range impinging upon said electron beam, and a second x-ray conversion target position not impinging upon said electron beam; and

said positioning assembly includes a means for moving said at least one target object mounted on said mounting apparatus between a first target object position range corresponding to said first x-ray conversion target position range at which said at least one target object is positioned in the path of x-rays emitted by said x-ray conversion target and a second target object position not impinging upon said electron beam.

43. The apparatus as set out in claim 41 further comprising an irradiation enclosure defining an interior space wherein said first x-ray conversion target position and said first target object position are within the interior space defined by said irradiation enclosure and said second x-ray conversion target position and said second target object position are outside said irradiation enclosure.

44. The apparatus as set out in claim 41 wherein said x-ray conversion target is substantially planar.

45. The apparatus as set out in claim 41 wherein said x-ray conversion target has an arcuate cross-sectional shape.

46. Apparatus for irradiating target objects comprising:

an electron beam source providing a beam of electrons on a path;

a rotatable carousel including:

a plurality of x-ray conversion targets circumferentially positioned on said carousel, each of said plurality of x-ray conversion targets including an x-ray generating material activated by said beam of electrons to emit x-rays when positioned in the path of the electron beam;

a plurality of mounting stations to receive at least one of said target objects, each of said mounting stations associated with one of said x-ray conversion targets and located on said carousel downstream its associated x-ray conversion target in the path of x-rays emitted from the associated x-ray conversion target when the x-ray generating material of the associated x-ray conversion target is activated by said beam of electrons to emit x-rays.

47. Apparatus irradiating target objects comprising:

an electron beam source providing a beam of electrons;

an x-ray conversion target in fixed relation to the electron beam source in the path of the beam of electrons from the electron beam source, the x-ray conversion target including an x-ray generating material activated by the beam of electrons to emit said x-rays;

an electron beam directing apparatus between the electron beam source and the x-ray conversion target; and

a retaining apparatus retaining the target object in fixed relation to said electron beam source.

48. Apparatus irradiating target objects comprising:

an x-ray source means for generating x-rays; and

a positioning means for positioning at least one of the target objects in the path of said x-rays emitted by said x-ray source means, including means for moving at least one of the target objects in relation to said x-rays emitted by said x-ray source means.

49. The apparatus as set out in claim 48 wherein said x-ray source comprises:

an electron beam source means providing a beam of electrons;

an x-ray conversion target means in fixed relation to the electron beam source in the path of the beam of electrons from the electron beam source, the x-ray conversion target including an x-ray generating material means for emitting x-rays when activated by said beam of electrons.

50. The apparatus as set out in claim 47 wherein said positioning means comprises a carousel means including target object mounting means.

51. Apparatus for irradiating target objects comprising:

an electron beam source providing a beam of electrons;

a positioning means including a means for linearly translating a translation armature for linear motion in an axial direction, and said translation armature including a mounting means for retaining at least one of said target objects; and

an x-ray conversion target means mounted on said translation armature between said translation armature and said electron beam source, wherein said x-ray conversion target means defines a radial access region providing access to said at least one target object and said x-ray conversion target includes an x-ray generating material activated by said beam of electrons to emit x-rays.

52. Method of irradiating target objects comprising:

providing a beam of electrons;

positioning an x-ray conversion target in fixed relation to said beam of electrons and impinging upon and receiving said beam of electrons;

emitting x-rays from the x-ray conversion target when activated by said beam of electrons; and

moving at least one of the target objects in relation to said x-ray conversion target and in the path of the x-rays emitted by said x-ray conversion target.

53. Method of irradiating a target object in a rotatable carousel having an axis of rotation comprising:

placing a target object in an aperture in the rotatable carousel;

providing a beam of electrons substantially perpendicular to said axis of rotation of the carousel;

activating an x-ray generating material in the rotatable carousel with said beam of electrons to emit x-rays;

receiving at least a portion of said x-rays in said aperture.

54. An irradiated medical stent produced using a process comprising the steps of:

providing a beam of electrons;

providing an x-ray conversion target in fixed relation to the beam of electrons;

emitting x-rays from the x-ray conversion target when activated by said beam of electrons; and

moving at least one of the target objects in the path of said x-rays emitted by the x-ray conversion target.